N91-21371

A Computer Model of the Electrostatic Positioning System

G.M. Gutt
Jet Propulsion Laboratory
California Institute of Technology
Pasadena, CA 91109

Positioning systems based upon electrostatic forces are being developed for the containerless processing of materials that cannot use acoustic or electromagnetic positioning techniques. Currently, electrode configurations for these electrostatic systems are designed on the basis of approximate analytical calculations and past experience. A three-dimensional computer model is being developed that will predict the electrostatic fields and forces for a given electrode configuration and will allow for a more rapid evaluation of proposed designs. Early results of this model will be presented.

THREE-DIMENSIONAL, NUMERICAL MODELING
OF ELECTROSTATIC POSITIONING SYSTEMS

PURPOSE OF THE MODEL

- TO DETERMINE THE ELECTRIC FIELD AND CHARGE DISTRIBUTIONS WITHIN THE CHAMBER AND ON THE SURFACES OF SAMPLES, SO AS TO AID THE SCIENTIFIC UNDERSTANDING OF THE EFFECTS OF ELECTROSTATIC POSITIONING ON THE SAMPLE

- TO PROVIDE AN ENGINEERING TOOL FOR THE EFFICIENT DESIGN OF FUTURE ELECTROSTATIC POSITIONING SYSTEMS

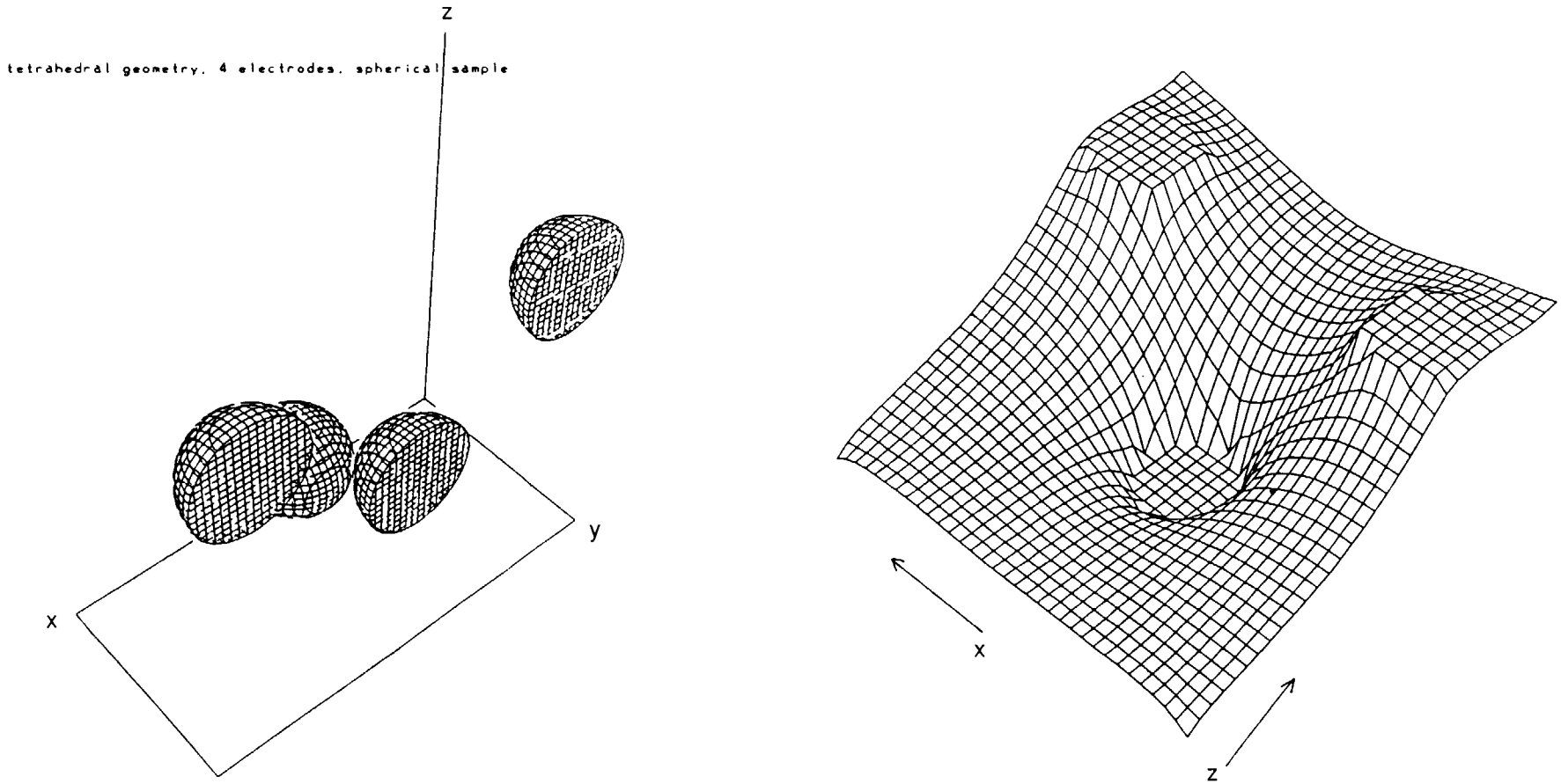

Figure 2: Cross-sectional view of a tetrahedral positioner, and plot of electric potential at the surface of the cross section.

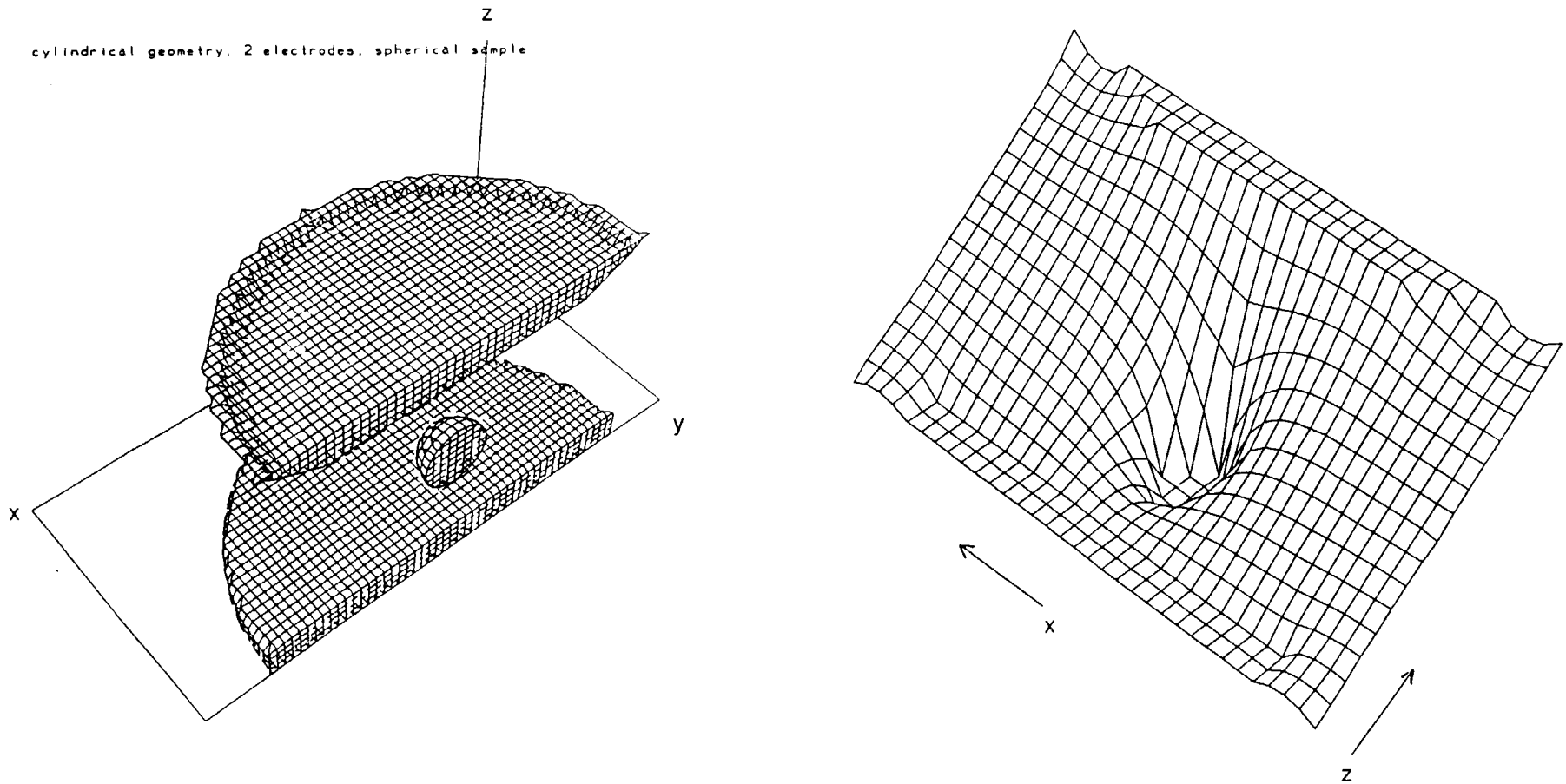

Figure 1: Cross-sectional view of single-axis positioner, and plot of electric potential at the surface of the cross section.

THREE-DIMENSIONAL, NUMERICAL MODELING
OF ELECTROSTATIC POSITIONING SYSTEMS

THE NUMERICAL MODEL

- A THREE-DIMENSIONAL, FINITE-DIFFERENCE MODEL IS USED
- INITIALLY, IT MODELS THE CASE OF SOLID CONDUCTORS IN A STATIC ELECTRIC FIELD
- FUTURE IMPROVEMENTS WILL INCLUDE DIELECTRICS, ELECTRON BEAMS, STATIC MAGNETIC FIELDS, THERMIONIC EMISSION, AND LIQUID SAMPLES
- IT ALLOWS FOR A VARIETY OF ELECTRODE SHAPES AND CONFIGURATIONS
- IT USES A MULTIGRID METHOD TO SOLVE FOR THE POTENTIAL FIELD
- IN FUTURE, IT WILL USE AN ADAPTIVE GRID REFINEMENT TECHNIQUE TO MORE ACCURATELY HANDLE HIGH FIELD REGIONS